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# Escape velocity and satellites

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

| Result | Formula | Units or note |
|---|---|---|
| **Escape speed** | v_e = root(2 G M/R) = root(2 g R) Valid when: launch from the surface of a spherical body, ignoring air and other bodies | m/s |
| **Orbital speed** | v_o = root(G M/r) = R root(g/r) Valid when: circular orbit of radius r about a spherical mass M | m/s |
| **Relation** | v_e = root 2 x v_o at the same radius Valid when: circular orbit and escape from the same radius r | dimensionless |
| **Period** | T = 2 pi root(r^3/(G M)) Valid when: circular orbit of radius r about a spherical mass M | s |
| **Kinetic energy of satellite** | KE = G M m/(2r) Valid when: circular orbit about a spherical mass, zero of PE at infinity | J |
| **Potential energy of satellite** | PE = -G M m/r Valid when: point or spherical masses, zero of PE at infinity | J |
| **Total energy** | E = -G M m/(2r) = -KE Valid when: circular orbit about a spherical mass, zero of PE at infinity | J |
| **Energy to change orbit** | G M m/2 x (1/r1 - 1/r2) Valid when: moving between two circular orbits r1 < r2 (energy supplied to go up) | J |
| **Near-surface values (Earth)** | v_o = 7.9 km/s, v_e = 11.2 km/s, T = 84.6 min | km/s (min) |
| **Geostationary orbit** | T = 24 h, r about 4.22 x 10^7 m, equatorial, west to east | h (m) |

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/gravitation/escape-velocity-and-satellites

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